**Shaken or Stirred? Financial Stability Under U.S.-China Tensions**

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**Abstract**

This study investigates how U.S.-China geopolitical tensions spread through global financial markets, commodities, and volatility channels, using a dynamic connectedness approach based on the time-varying parameter vector autoregressive (TVP-VAR) model. Results reveal that during the pre-trade war globalization period, systemic risk transmission was primarily market-driven, with the S&P 500 and VIX leading spillovers, while geopolitical tensions remained passive. In contrast, the post-2018 period exhibits heightened interconnectedness, with volatility (the VIX) and geopolitical tensions (the UCT) emerging as active transmitters of systemic risk, while commodities and exchange rates become critical transmission channels during crises. These findings highlight a structural shift from market-led stability to volatility- and tension-driven systemic spillovers under global stress. They provide valuable insights for policymakers and investors operating in an increasingly fragile financial landscape.

*Keywords*: Connectedness, TVP-VAR, US-CHINA, Tension, Gold, Oil

*JEL classifications*:

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1. **Introduction**

The geopolitical rivalry between the United States and China has emerged as one of the defining risks to global financial stability. Once bound together by deepening economic ties, the two powers are now locked in strategic competition, with escalating tensions around trade, technology, national security, and global influence. These persistent frictions have not only upended global supply chains and foreign policy dynamics, but have also become a systemic driver of financial market uncertainty.

Nevertheless, the transmission mechanisms through which U.S.-China tensions spill over into global financial systems remain underexplored. Most existing studies focus on isolated geopolitical events or rely on broad indices such as the Geopolitical Risk Index (GPR), offering limited insight into the evolving role of bilateral tensions. Moreover, foundational work by Jurado et al. (2015) has shown that uncertainty, when properly measured, has distinct and powerful effects on asset prices. What is missing is a dynamic, multi-asset analysis of how these geopolitical shocks interact with equity markets, currencies, commodities, and volatility, especially over time and across distinct geopolitical regimes.

While recent studies have begun examining U.S.-China tensions in financial contexts, they remain largely segmented.[[1]](#footnote-1) Peng et al. (2025) assess the impact of U.S.-China tensions on stock market performance using a time-varying quantile causality framework, while Sha et al. (2025) document how geopolitical frictions influence corporate ESG outcomes. Cai (2025) highlights the consequences of U.S.-China tensions for global supply chains and macroeconomic outcomes, while Liu et al. (2025) demonstrate the effects of these tensions on foreign direct investment (FDI) and volatility in fossil fuel prices. These studies offer valuable perspectives, but tend to focus on specific themes or narrow market segments. Our study complements and extends this work by adopting a broader macro-financial lens, mapping how bilateral tensions propagate systemically through key global asset classes.

Specifically, we explore whether U.S.-China tensions influence systemic connectedness differently during stable versus crisis periods. In addition, we investigate how their role has evolved from passive receivers to active transmitters of risk and whether traditionally safe-haven assets like gold and oil mitigate or amplify geopolitical shocks. Finally, we also examine whether volatility, as measured by the VIX, mediates or intensifies the impact of geopolitical uncertainty.

We contribute to the literature by integrating the newly developed U.S.-China Tension Index (UCT)—a monthly, text-based measure of bilateral geopolitical stress—into a TVP-VAR connectedness framework. This methodology, pioneered by Antonakakis and Gabauer (2017), allows for time-varying estimations without relying on arbitrary rolling windows. Thus, it is especially well-suited for analyzing long-term structural shifts and market fragility under uncertainty.

Recent literature has underscored the financial consequences of geopolitical shocks. Caldara and Iacoviello (2022) report that geopolitical risks depress equity returns and boost global volatility. Similarly, Liu and Zhang (2024) show that geopolitical uncertainty significantly affects excess returns on currency, highlighting its broader impact on cross-asset pricing, particularly through regional and country-specific risk components. In addition, Pastor and Veronesi (2013) demonstrate that political uncertainty raises equity risk premia and suppresses investment, highlighting the broader implications of policy-driven shocks for financial markets. However, most studies rely on static or linear models. They seldom isolate the effects of sustained bilateral tensions such as those between the U.S. and China.

A smaller strand of research has applied dynamic models to the examination of financial contagion and volatility. Antonakakis and Gabauer’s (2017) TVP-VAR model offers a flexible framework for capturing evolving spillovers, and has been adopted in the financial connectedness literature (e.g., Umar & Gubareva, 2020). However, to our knowledge, no study has applied this model to assess the financial impact of sustained U.S.-China geopolitical risks.

Another unresolved debate concerns the role of commodities during crises. While gold is typically considered a safe haven (Baur & McDermott, 2010), its behavior under structural geopolitical stress, such as a prolonged U.S.-China conflict, remains ambiguous. Similarly, oil is often treated as an amplifier of risk due to its sensitivity to global supply and demand shocks. By placing these assets within a connected network, we offer new insights into their systemic roles.

Our empirical analysis uses monthly data from 1993 to 2024. We chose this time period to cover two distinct periods: the pre-2018 era defined by market-led globalization, and the post-2018 regime marked by trade wars, uncertainty resulting from the pandemic, and renewed geopolitical conflicts. Using a time-varying parameter VAR with generalized forecast error variance decomposition allows us to trace how tensions flow through financial markets and how the system itself evolves in response to global shocks. In doing so, we present the first dynamic, multi-asset connectedness study focused on U.S.-China geopolitical tensions. Our findings provide academics, investors, and policymakers with new perspectives for navigating a more fragile and politically charged financial landscape.

1. **Data**

The U.S.-China Tension Index (the UCT; Rogers, Sun, & Sun, 2024) is a monthly measure capturing the intensity of geopolitical frictions between the United States and China. It is constructed using analyses of newspaper texts. The index quantifies the frequency of articles that talk about contentious issues in bilateral relations using language that signals tensions. The result is an index that provides a consistent, time-series indicator of geopolitical strains from 1993 onward. The UCT has been shown to align with periods of heightened diplomatic conflict and policy uncertainty, making it a suitable proxy for examining how geopolitical tensions influence financial markets and systemic connectedness.

The network analysis in this study incorporates the rate of change (returns) of seven key variables to capture the interplay between geopolitical tensions, US and China financial markets, implied volatility, exchange rate, and oil and gold. The U.S.-China Tension Index (UCT) proxies for risk and bilateral tensions between the United States and China. The S&P 500 Index (S&P) and the CSI 300 Index (CHINA) represent major equity markets in the U.S. and China, respectively. The VIX Index (VIX) serves as a gauge of implied volatility and investor uncertainty in U.S. markets. The USD/CNY exchange rate[[2]](#footnote-2) reflects the dynamics of the Chinese yuan against the U.S. dollar, capturing exchange rate pressures during tensions and financial events.

Finally, Gold and crude Oil prices are included to represent key commodities that often respond to shifts in risk sentiment and global economic conditions. Gold, in particular, is widely regarded as a safe-haven asset and a hedge during periods of heightened uncertainty, while Oil prices reflect supply shocks and global demand dynamics. Both commodities thus provide additional pathways through which geopolitical tensions may propagate and interact with financial markets within the global financial system.

The analysis utilizes monthly data starting from January 1993 (matching the start of the UCT index) through the most recent available observations, covering the period until February 2024. To balance the theoretical needs of the research and the sample size constraints, we divide the data into two primary periods: (1) a pre-trade war globalization period from January 1993 to December 2017, characterized by accelerated globalization and lower systemic geopolitical tensions, and (2) a trade war and post-pandemic tension period from January 2018 to December 2024, marked by the U.S.-China trade war, the COVID-19 pandemic, and heightened geopolitical frictions. This division allows us to capture structural shifts in the connectedness structure under different geopolitical environments while maintaining sufficient observations for reliable VAR and TVP-VAR estimation in each subperiod.

**Table 1** reports the descriptive statistics of the variables under examination, including the U.S.-China Tension Index (UCT), the S&P 500, CSI 300, VIX, USD/CNY exchange rate, Gold, and Oil prices. Across the full sample and within subperiods, the UCT and VIX exhibit the highest standard deviation, consistent with spikes during periods of financial and geopolitical stress, such as the 1997 financial crisis, the 2008 global financial crisis, the escalation of U.S.-China trade tensions in 2018, and the COVID-19 pandemic in 2020. For example, the UCT exhibits a standard deviation of 0.197 in the full period and (0.200) 0.185 (pre) post-2018, The VIX shows a standard deviation of 0.223 in the entire period, underscoring its role in representing episodic stress. The equity indices and commodity prices exhibit less volatility on average but display periods of heightened fluctuations around key events. Skewness and kurtosis measures, along with significant Jarque-Bera test statistics, indicate departures from normality across most series, underscoring the appropriateness of using VAR-based connectedness frameworks in the subsequent analysis.

1. **Method**

We utilized a TVP-VAR (1) model using the framework of Antonakakis and Gabauer (2017) and building on the connectedness measures of Diebold and Yilmaz (2009, 2012, 2014).[[3]](#footnote-3) Diebold and Yilmaz employed rolling-window VAR models to track the transmission of shocks in financial systems. Antonakakis and Gabauer extended this investigation by using a TVP-VAR approach with a time-varying covariance structure (Primiceri, 2005). Doing so allowed the measures of connectedness to adjust dynamically to structural changes without relying on fixed window lengths. The TVP-VAR approach has been widely applied (Aharon & Demir, 2021; Aharon, Umar & Vo, 2021; Umar, Yousaf, & Aharon, 2021; Aharon, Demir, & Ersan, 2023). It is particularly appropriate for smaller size or volatile samples, as it can capture time-varying dynamics without requiring large subsample windows. Thus, the TVP-VAR approach is well-suited for examining periods of structural change and heightened market uncertainty.

Formally, the TVP-VAR(1) system can be expressed as:

, (1)

(2)

where denotes the vector of endogenous variables, ​ is the time-varying parameter matrix, and is the time-varying variance-covariance matrix of the error terms. Applying the Wold decomposition, the system can be equivalently represented in its infinite-order vector moving average (VMA) form:

, (3)

where captures the dynamic impulse responses of the system to shocks.

To quantify connectedness, we used the generalized forecast error variance decomposition (GFEVD) within this TVP-VAR framework to ensure invariance regardless of the ordering of the variables. The H-step ahead GFEVD for the impact of shocks in variable *j* on variable *i* at time *t* is calculated as:

(4)

where is the inverse of *jth* diagonal element of , and is a selection vector. These values are normalized as:

(5)

to interpret the relative contribution of each variable to the forecast error variance of the others.

Using these normalized decompositions, we computed the Total Connectedness Index(TCI) as:

. (6)

which captures the overall degree of interconnectedness in the system at each point in time. Directional connectedness received by variable *i* from all other variables j is measured as:

(7)

Similarly, the *spillovers transmitted* by variable *i* TO all other variables *j* is calculated as:

(8)

To measure the *net pairwise directional connectedness*, we subtracted the total directional connectedness to others from the total directional connectedness from others. The result can be considered the influence that variable *i* has on the analyzed network. Thus,

(9)

1. **Results**

Table 3 and Figure 2 indicate the results of the connectedness analysis for the entire sample period (1993–2024) and its subperiods. The table and the figure reveal a clear evolution in the sources and channels of systemic risk transmission in the global markets.

Over the entire period (1993–2024), these dynamics average out to a system where financial markets (S&P), volatility (VIX), and gold are the primary transmitters of systemic risk. Geopolitical tensions (UCT) play a supporting transmission role. Table 3 (Panel A) shows a Total Connectedness Index (TCI) of 23.84%, indicating moderate systemic interconnectedness. The S&P 500 is a leading transmitter of risk, with the UCT, VIX, and oil acting as supporting transmission channels. The Chinese capital market acts as a passive participant, primarily receiving rather than transmitting shocks (NET = -7.07).

During the pre-trade war globalization period (1993–2017), the overall level of connectedness (TCI=23.77) is still moderate, indicating a globally integrated but relatively stable system. Nevertheless, the system is characterized by several changes in terms of the sources and recipients of risk. While the S&P 500 consistently emerged as a transmitter of shocks (TO=38.8, NET=3.62), reflecting the key role of the U.S. market in the global financial system, the bottom net line reveals that during this period the S&P 500 was no longer the dominant transmitter of risk. Indeed, the VIX even became a net recipient of shocks despite its total spillovers to others (TO=37.68). On the other hand, the USD/CNY became a new dominant transmitter of risk (NET=6.42), with gold and the UCT also acting as significant transmitters. China’s equity market and oil were recipients, reflecting China's growing integration into global markets and the importance of oil prices in systemic spillovers.

In the trade war and post-pandemic period (2018–2024), the structure of spillovers shifted dramatically. The Total Connectedness Index (TCI) surged to 77.83%, more than tripling relative to the pre-trade war period (~24%). This spike indicates increased systemic fragility and tighter interconnections during periods of global stress. It also reflects a sharp rise in systemic spillovers during the trade war and post-COVID era. These results suggest that during this time period, the inter-market transmission of shocks became the dominant feature of the system.

In addition, during this period gold was the leading net transmitter of shocks (NET = 36.14). While it had high total spillovers compared to other variables (TO = 97.38%), it received only 61.23% spillovers from other variables. Gold is conventionally viewed as a safe-haven asset that absorbs systemic shocks during periods of heightened uncertainty. However, the results from the post-2018 period (Panel C, Table 3) show that gold exhibited a positive net connectedness value of 36.14, positioning it as a dominant transmitter of systemic risk. During crises, a sharp surge in the demand for gold can lead to abrupt price movements. These price shocks, while stemming from gold's role as a haven, can transmit volatility to other markets, particularly equities and currencies, as investors rebalance their portfolios. Gold prices often reflect collective investor sentiment. A sharp rally in gold might not be just a hedge against risk. It may also signal escalating global fear, triggering reactions across other markets. In this way, gold amplifies the *perception* of risk, effectively becoming a channel for spillovers

In the trade war and post-pandemic period, China’s equity market (CSI 300) also emerged as a dominant net transmitter of risk (NET = 31.61), suggesting its growing influence and proactive role in propagating risk. These results highlight the growing role of China and commodities in amplifying systemic shocks in times of geopolitical uncertainty. The S&P 500 became the largest net receiver of shocks (NET = -19.22, FROM = 78.6%, TO = 59.38%), signaling a reversal in its traditional leadership role observed in earlier periods. Oil was also a major net recipient of risk (NET = -36.6), absorbing considerable shocks from the system. This role likely reflecting oil’s sensitivity to geopolitical disruptions, especially in the wake of the Russia-Ukraine conflict and volatility in the Middle East. The UCT Index remained a net recipient of risk (NET = -3.05) despite its extensive gross involvement (TO = 79.08%, FROM = 82.12%). This result implies that the UCT reflects market-wide sentiments rather than being an independent driver of connectedness.

This structural reversal highlights a regime change. During heightened geopolitical stress and post-pandemic uncertainty, China’s financial signals and gold’s safe-haven dynamics dominated the direction of systemic flows. These results imply that markets increasingly responded to developments from China and the revaluation of risk via gold, rather than U.S. market volatility alone.

An intriguing finding lies in the changing role of the UCT index across the subperiods. In the pre-trade war era (1993–2017), the UCT acted as a modest net transmitter of shocks (+1.23), reflecting its influence on markets during times of geopolitical shifts. However, in the trade war and post-pandemic period (2018–2024), the index became a net recipient (–3.05), suggesting a reversal in directionality. Rather than driving market volatility, geopolitical tension was increasingly shaped by market movements. This shift implies that the UCT has evolved from a source of systemic risk to a barometer of financial stress, capturing the growing endogeneity between geopolitical narratives and global market dynamics.

Figure 3 reveals a clear structural evolution in systemic interconnectedness across global financial markets. During the 1990s and early 2000s, total connectedness was relatively high and volatile, peaking above 40%. This high level of connectedness and volatility reflected market adjustments during the Asian financial crisis, the dot-com bubble, and other global shocks. However, from 2003 to 2017, the system stabilized, with total connectedness hovering around 15%–20%. This stability indicated a more segmented and market-oriented environment typical of the pre-trade war globalization era.

A notable inflection point occurred post-2018. Connectedness began to trend upward, surpassing 30% and remaining persistently elevated through 2024. This rise aligns with the onset of the U.S.-China trade war, the COVID-19 pandemic, and escalating geopolitical tensions. This increase also suggests that systemic shocks became more synchronized across markets, reducing the benefits of diversification. The persistence of this high degree of connectedness post-2020 reflects a new regime of financial fragility dominated by risk spillovers from geopolitical and volatility shocks rather than purely economic fundamentals.

While the dynamic total connectedness in Figure 3 appears to fluctuate within a moderate range over the entire sample, averaging below 30% for long periods, the average connectedness in the post-2018 subperiod (Panel C, Table 3) surges to 90.8%. This apparent discrepancy reflects the smoothing effect of long-term aggregation. It masks recent structural breaks and highlights the importance of subsample analysis for revealing regime shifts in systemic risk.

Figure 4 provides a clear visual contrast between the two subsample periods. During the pre-trade war globalization period (1993–2017), dynamic total connectedness (TCI) remained relatively low and stable, fluctuating mostly between 15% and 25%, with a gradual decline over time. This statistic suggests that the transmission of systemic risk was moderate and largely driven by market fundamentals in a relatively tranquil geopolitical environment.

In sharp contrast, during the trade war and post-pandemic period (2018–2024) there was a sustained surge in the TCI, with values consistently exceeding 80% and peaking near 100% in early 2018 and mid-2020. These peaks align with key geopolitical stress points such as the escalation of U.S.-China trade tensions and the onset of the COVID-19 pandemic. This shift is also reflected in the average TCI values reported in Table 3, Panel C (90.8%) compared to Panel B (23.77%), confirming a structural break in systemic connectedness.

Figure 5, Figure 6, and Figure 7 provide a comprehensive view of the evolution of the roles that each variable played in net connectedness during the entire sample period (1993–2024) and the two subperiods, respectively. These figures offer critical insights into how the systemic roles of these variables shifted over time and regimes, particularly in response to geopolitical disruptions such as the U.S.–China trade war and the COVID-19 pandemic.

Figure 5, which displays the dynamic net connectedness for the entire sample, reveals distinct patterns across assets. Notably, the S&P 500 and gold were consistently positive in the earlier part of the sample. They served as net transmitters of shocks, particularly during episodes of market-driven turbulence in the 1990s. By contrast, China, oil, and USD/CNY often acted as net receivers, absorbing systemic volatility rather than initiating it. The VIX index remained primarily a net recipient over time, consistent with its role as a reflection of market uncertainty rather than an originator of shocks. The UCT index, representing U.S.–China tensions, played a relatively marginal role during the earlier decades, exhibiting little net connectedness until the late 2010s.

This structural stability shifts sharply in Figure 6, which isolates the pre-trade war globalization period (1993–2017). During this era of declining geopolitical frictions and increasing financial integration, market fundamentals dominated systemic risk propagation. The S&P 500, gold, and VIX were the primary net transmitters, particularly in the earlier years (1993–2000), supporting the interpretation that risk dynamics were largely market-driven. Meanwhile, the UCT remained largely passive, confirming that the tensions did not constitute a primary channel of systemic financial stress during this time.

However, Figure 7, which focuses on the trade war and post-pandemic period (2018–2024), presents a substantially altered network topology. Here, China, and especially gold, emerge as persistent and dominant net transmitters of systemic shocks. The case of gold is particularly striking. Traditionally considered a safe-haven asset, it transitioned during this subperiod into a source of volatility propagation. This behavior, especially pronounced between 2020 and 2021, may reflect gold’s increased sensitivity to coordinated policy shocks, inflation fears, and safe-haven capital flows during global crises. Such a change in behavior suggests that its systemic role has evolved from an absorber of shocks to a transmitter of them during periods of extreme stress.

Simultaneously, the UCT’s net connectedness turns more negative in this period (see Panel C in Table 3 and Figure 7). This change indicates that while the index becomes more interconnected, meaning that its spillovers increase, it does so primarily as a net recipient of shocks rather than an instigator of them. This nuanced role suggests that geopolitical tensions, as captured by media sentiment, reflect rather than drive systemic instability—particularly during times of broader global disruptions.

During this period, oil, the USD/CNY, and the VIX continued to absorb rather than initiate shocks, underscoring their function as transmission channels rather than sources of shocks. These assets remained responsive to broader uncertainty, monetary tightening, and geopolitical risks, reaffirming their importance in the volatility cascade during crises.

1. **Policy Implications and Recommendations**

The empirical findings of this study have critical implications for global financial governance in an era of rising geopolitical uncertainty. The structural shift in systemic connectedness—marked by a transition from the market-led transmission of shocks to the volatility- and tension-driven transmission of shocks—requires international institutions to recalibrate their macro-financial surveillance frameworks. The post-2018 regime, characterized by the increasing systemic influence of China’s financial markets and commodities such as gold, alongside the endogenous evolution of geopolitical risk, presents new challenges for safeguarding financial stability.

Based on these findings, we outline several concrete policy recommendations for global institutions such as the International Monetary Fund (IMF), World Bank, Bank for International Settlements (BIS), and Financial Stability Board (FSB).

1. **Reframing Geopolitical Risk as Endogenous Financial Stress**

A key insight from this study is the evolving role of the U.S.-China Tension Index (UCT). While the UCT was a modest net transmitter of shocks in the pre-trade war period (1993–2017), it became a net recipient during the trade war and post-pandemic period (2018–2024). This structural reversal implies that geopolitical tensions no longer operate as purely exogenous sources of instability. Instead, they increasingly reflect underlying market dynamics. In this new regime, the UCT serves as a barometer of financial stress, shaped by and reinforcing systemic volatility and cross-asset contagion.

This transformation has major implications for global surveillance efforts. Institutions such as the IMF and BIS should expand their systemic risk monitoring frameworks to recognize geopolitical risk as both a driver and a reflection of market fragility. Early warning systems must integrate such feedback loops, where volatility and market sentiment amplify political narratives, which in turn accelerate financial instability. Risk assessments must therefore capture the endogenous nature of geopolitical stress to avoid underestimating its systemic role.

1. **Integrate Bilateral Geopolitical Indicators into Financial Surveillance**

Current global monitoring frameworks often rely on broad geopolitical risk indices, overlooking the asymmetric and bilateral nature of key geopolitical rivalries. Given our evidence that U.S.–China tensions increasingly propagate through financial markets, institutions should incorporate more targeted bilateral indicators—such as the UCT—into existing surveillance platforms. For example, the IMF’s Financial Sector Assessment Program (FSAP) and World Bank’s risk analytics could use bilateral tension indices as systemic stress markers to refine the classifications of risk for countries, especially for economies heavily exposed to trading with, financial flows to or from, or supply chain integration with either China or the United States.

1. **Expand Macroprudential Toolkits to Account for Volatility-Driven Spillovers**

The rising role of the VIX and commodity-linked volatility channels as dominant transmitters of systemic risk post-2018 highlights the need to embed volatility sensitivity in macroprudential regulation. Global institutions should recommend capital surcharges or liquidity buffers that adjust dynamically to implied volatility measures. Additionally, scenario analysis within stress testing frameworks—both at the national and multilateral levels—should include geopolitical volatility shocks as core components, recognizing their ability to propagate across asset classes.

1. **Strengthen Commodity Risk Mitigation Frameworks in Resource-Vulnerable Economies**

Our analysis reveals that gold and oil, while traditionally considered hedging assets, can become transmitters of systemic shocks during periods of geopolitical stress. This duality requires international financial institutions, particularly the World Bank and IMF, to support commodity-importing and exporting nations in building institutional hedging mechanisms. Policy tools may include subsidized access to risk management products, expanded use of commodity-linked catastrophe bonds, and the provision of preemptive budget stabilization support through facilities such as the IMF’s Resilience and Sustainability Trust.

1. **Incorporate Geopolitical Spillovers into Sovereign Risk and Lending Assessments**

The observed rise of China as a dominant transmitter of shocks implies that financial contagion may increasingly originate from non-traditional sources. Countries with significant exposure to Chinese capital markets, trade, or foreign direct investment (FDI) may face elevated systemic risk even if their domestic fundamentals appear stable. Therefore, the sovereign risk frameworks used by the IMF, World Bank, and credit rating agencies should account for such second-order contagion pathways in their debt sustainability assessments and program conditionality designs. Taking these steps would enable more comprehensive risk pricing and improve pre-crisis funding interventions.

1. **Establish a Multilateral Geopolitical Risk Observatory**

To institutionalize forward-looking geopolitical risk monitoring, we recommend the creation of a "Multilateral Geopolitical Risk Observatory," led jointly by the IMF, World Bank, and BIS. This platform would centralize the tracking of bilateral and multilateral tensions using high-frequency, text-based indices such as the UCT, complemented by geopolitical sentiment analytics and market-based signals such as capital flow reversals or volatility spikes. The Observatory would publish periodic risk dashboards and coordinate scenario planning exercises for use in national and global stress testing.

1. **Promote Crisis Communication Protocols to Dampen Systemic Feedback Loops**

Given the feedback-driven nature of systemic risk in the post-2018 regime, coordinated crisis communication becomes a critical stabilizing tool. The FSB and BIS should encourage central banks and financial regulators to adopt joint messaging strategies during episodes of geopolitical stress, especially when safe-haven flows, gold price spikes, or currency movements threaten to trigger disorderly rebalancing. Liquidity swap lines, multilateral credit backstops, and synchronized policy announcements can help mitigate market overreactions and reduce contagion risks.

1. **Build Resilience in Financial Systems Exposed to Geopolitical Contagion**

Finally, technical assistance programs provided by multilateral development banks should prioritize resilience-building in financial systems with high levels of geopolitical exposure. These efforts should focus on increasing capital market depth, promoting exchange rate flexibility, improving sovereign risk modeling, and developing domestic volatility insurance markets. Such support should be embedded in broader fiscal and financial sector strategies—particularly in low- and middle-income countries facing rising geopolitical spillovers from the rivalry between stronger powers.

1. **Conclusion**

This paper explores how U.S.–China geopolitical tensions, as captured by the newly developed U.S.–China Tension (UCT) Index, affect the transmission of shocks across global financial markets. Employing a time-varying parameter vector autoregression (TVP-VAR) model, the study quantifies the dynamic connectedness among key financial variables, including the S&P 500, CSI 300, VIX, USD/CNY exchange rate, gold, and oil between 1993 and 2024. The analysis distinguishes between two subperiods: the pre-trade war globalization era (1993–2017) and the trade war/post-pandemic period (2018–2024).

The results reveal a marked shift in systemic risk dynamics. During the earlier period, financial spillovers were predominantly market-driven, with the S&P 500, the VIX, and gold acting as net transmitters of volatility, while the UCT index remained largely passive. In contrast, the post-2018 period shows heightened interconnectedness, with gold and China becoming dominant transmitters of shocks. During this period, most other variables, particularly the VIX and UCT, acted as net recipients. Notably, gold’s transformation from a traditional safe haven to a transmitter of shocks reflects changing investor behavior during periods of extreme uncertainty.

Dynamic connectedness indices confirm this structural shift. The Total Connectedness Index (TCI) nearly quadrupled in the second subperiod, indicating a more fragile and interlinked global system. These findings highlight the growing influence of tensions in shaping financial contagion patterns and have important policy implications. Investors and regulators must increasingly consider non-traditional sources of risk, such as political conflicts, in managing systemic risk.

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Peng, C., Deng, H., Xie, J., Liu, X. 2025. US-China Tension and Stock Market Performance in US and China: New Insights from Time-varying Quantile Causality Method*.* Finance Research Letters. <https://doi.org/10.1016/j.frl.2025.107888>

Sha, F., Meng, J., Zheng, X., Jiang, Y. 2025. Sustainability Under Fire: How China-US Tensions Impact Corporate ESG Performance? Finance Research Letters. <https://doi.org/10.1016/j.frl.2025.107882>

Umar, Z., Gubareva, M. 2020. [A time–frequency analysis of the impact of the Covid-19 induced panic on the volatility of currency and cryptocurrency markets](https://ideas.repec.org/a/eee/beexfi/v28y2020ics2214635020303312.html). [*Journal of Behavioral and Experimental Finance*](https://ideas.repec.org/s/eee/beexfi.html)*,* 28(C). <https://doi.org/10.1016/j.jbef.2020.100404>

Umar, Z., Polat, O., Choi, S.-Y., & Teplova, T. (2022). Dynamic connectedness between non-fungible tokens, decentralized finance, and conventional financial assets in a time-frequency framework. *Pacific-Basin Finance Journal*, 76, 101876. https://doi.org/10.1016/j.pacfin.2022.101876.

**Table 1: Descriptive Statistics**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Panel A. Entire period**  **(Jan 1993 – Feb 2024)** | | | | | | |
|  | **UCT** | **S&P** | **CHINA** | **Gold** | **VIX** | **USD/CNY** | **Oil** |
| **Mean** | 0.020 | 0.008 | 0.007 | 0.006 | 0.022 | 0.001 | 0.009 |
| **Median** | 0.005 | 0.012 | 0.003 | 0.000 | -0.006 | 0.000 | 0.012 |
| **Maximum** | 1.390 | 0.127 | 1.352 | 0.172 | 1.346 | 0.500 | 0.884 |
| **Minimum** | -0.609 | -0.169 | -0.312 | -0.168 | -0.459 | -0.034 | -0.542 |
| **SD** | 0.197 | 0.043 | 0.111 | 0.045 | 0.223 | 0.027 | 0.106 |
| **Skewness** | 1.349 | -0.590 | 4.906 | 0.239 | 1.524 | 16.463 | 1.124 |
| **Kurtosis** | 9.557 | 3.992 | 61.159 | 3.826 | 8.086 | 301.241 | 16.822 |
| **JB** | 781.346\*\*\* | 36.909\*\*\* | 54066.112\*\*\* | 14.171\*\*\* | 546.423\*\*\* | 1399246.775\*\*\* | 3047.810\*\*\* |
| **ERS** | -7.341\*\*\* | -7.537\*\*\* | -3.481\*\*\* | -7.562\*\*\* | -9.476\*\*\* | -7.471\*\*\* | -9.433\*\*\* |
|  | **Panel B. Pre-Trade War Globalization Period**  **(Jan 1993 – Dec 2017)** | | | | | | |
|  | **UCT** | **S&P** | **CHINA** | **Gold** | **VIX** | **USD/CNY** | **Oil** |
| **Mean** | 0.021 | 0.007 | 0.009 | 0.006 | 0.018 | 0.001 | 0.008 |
| **Median** | 0.004 | 0.011 | 0.006 | 0.000 | -0.006 | 0.000 | 0.009 |
| **Maximum** | 1.390 | 0.108 | 1.352 | 0.172 | 1.346 | 0.500 | 0.366 |
| **Minimum** | -0.609 | -0.169 | -0.312 | -0.168 | -0.385 | -0.021 | -0.326 |
| **SD** | 0.200 | 0.041 | 0.122 | 0.046 | 0.204 | 0.029 | 0.090 |
| **Skewness** | 1.442 | -0.697 | 4.578 | 0.205 | 1.665 | 16.415 | 0.015 |
| **Kurtosis** | 10.400 | 4.439 | 52.209 | 3.895 | 9.800 | 279.073 | 4.081 |
| **JB** | 785.985\*\*\* | 50.029\*\*\* | 31213.189\*\*\* | 12.076\*\*\* | 714.258\*\*\* | 962958.704\*\*\* | 14.580\*\*\* |
| **ERS** | -6.488\*\*\* | -6.496\*\*\* | -3.536\*\*\* | -6.878\*\*\* | -7.955\*\*\* | -6.698\*\*\* | -7.819\*\*\* |
|  | **Panel C. Trade War and Post-Pandemic Tensions**  **(Jan 2018 – Feb 2024)** | | | | | | |
|  | **UCT** | **S&P** | **CHINA** | **Gold** | **VIX** | **USD/CNY** | **Oil** |
| **Mean** | 0.017 | 0.010 | 0.000 | 0.007 | 0.039 | 0.001 | 0.015 |
| **Median** | 0.006 | 0.018 | -0.001 | -0.003 | -0.018 | 0.001 | 0.020 |
| **Maximum** | 0.675 | 0.127 | 0.138 | 0.109 | 1.129 | 0.042 | 0.884 |
| **Minimum** | -0.382 | -0.125 | -0.080 | -0.072 | -0.459 | -0.034 | -0.542 |
| **SD** | 0.185 | 0.052 | 0.045 | 0.039 | 0.291 | 0.016 | 0.154 |
| **Skewness** | 0.833 | -0.400 | 0.480 | 0.494 | 1.102 | 0.303 | 1.775 |
| **Kurtosis** | 4.373 | 2.846 | 3.185 | 2.702 | 4.632 | 2.938 | 16.943 |
| **JB** | 14.365\*\*\* | 2.042 | 2.946 | 3.285 | 23.185\*\*\* | 1.147 | 638.247\*\*\* |
| **ERS** | -2.199\*\* | -2.130\*\* | -2.013\* | -2.886\*\*\* | -3.021\*\*\* | -1.548 | -3.854\*\*\* |

**Notes:** This table summarizes the descriptive statistics for the study’s variables, including the mean, median, variance maximum, minimum, skewness, and kurtosis for each series. It also reports the results of the Jarque-Bera (1980) test for normality with p-values in parentheses, along with the total observation count for each period. Panel A provides the statistics for the entire sample (January 1993 to December 2024), while Panels B and C present the results for the pre-trade war globalization period (January 1993 to December 2017) and the trade war and post-pandemic period (January 2018 to December 2024), respectively

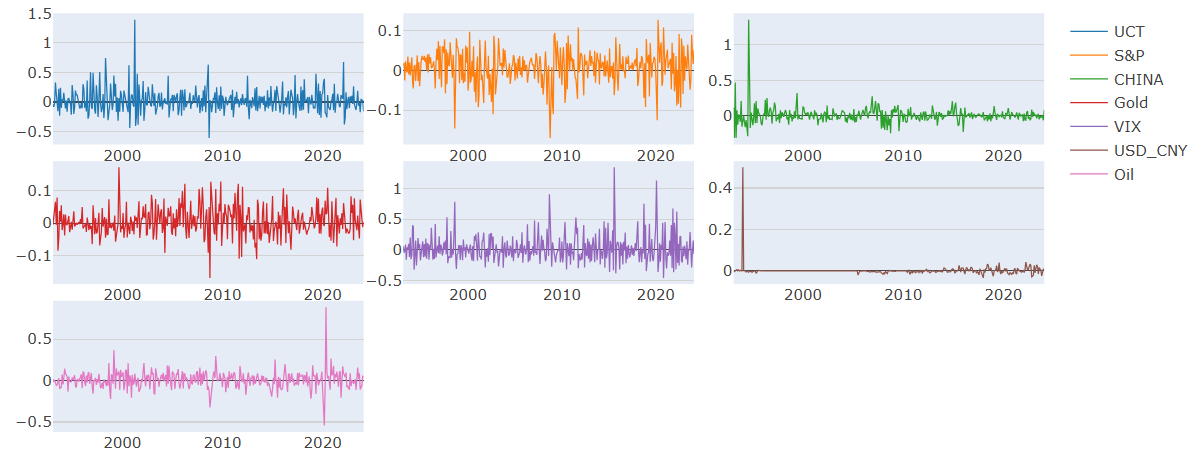
**Table 3: Static Connectedness Tables**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Panel A. Entire Period (Jan 1993 – Feb 2024)** | | | | | | | | |
|  | **UCT** | **S&P** | **CHINA** | **Gold** | | **VIX** | **USD/CNY** | **Oil** | **FROM** |
| **UCT** | **92.09** | 1.57 | 0.8 | 1.75 | | 1.97 | 0.44 | 1.38 | 7.91 |
| **S&P** | 1.16 | **63.18** | 2.11 | 1.69 | | 27.37 | 0.94 | 3.55 | 36.82 |
| **CHINA** | 1.61 | 5.03 | **86.37** | 0.93 | | 3.57 | 1.24 | 1.24 | 13.63 |
| **Gold** | 1.91 | 1.5 | 1.14 | **82.57** | | 1.12 | 9.74 | 2.03 | 17.43 |
| **VIX** | 1.88 | 27.91 | 1.01 | 1.6 | | **61.63** | 2.92 | 2.92 | 38.37 |
| **USD/CNY** | 0.16 | 0.5 | 0.78 | 9.65 | | 0.44 | **88.25** | 0.22 | 11.75 |
| **Oil** | 1.63 | 5.4 | 0.73 | 2.99 | | 3.13 | 0.22 | **82.89** | 17.11 |
| **TO** | 8.35 | 41.92 | 6.56 | 18.61 | | 39.2 | 11.35 | 17.11 | 143.02 |
| **In. own** | 100.43 | 105.1 | 92.93 | 101.18 | | 101.23 | 94.24 | 100 | **cTCI/TCI** |
| **NET** | 0.43 | 5.1 | -7.07 | 1.19 | | 1.23 | -8.88 | -5.76 | **23.84/20.43** |
| **NPT** | 3 | 4 | 1 | 3 | | 3 | 6 | 1 |  |
|  | **Panel B. Pre-Trade War Globalization Period (Jan 1993 – Dec 2017)** | | | | | | | | |
|  | **UCT** | **S&P** | **CHINA** | **Gold** | | **VIX** | **USD/CNY** | **Oil** | **FROM** |
| **UCT** | **92.7** | 1.46 | 0.81 | 1.96 | | 1.6 | 0.52 | 0.95 | 7.3 |
| **S&P** | 1.15 | **64.82** | 1.59 | 1.76 | | 27.26 | 0.91 | 2.52 | 35.18 |
| **CHINA** | 1.73 | 4.73 | **86.77** | 0.93 | | 3.53 | 1.02 | 1.29 | 13.23 |
| **Gold** | 2.14 | 1.38 | 1.01 | **79.4** | | 1.29 | 12.58 | 2.19 | 20.6 |
| **VIX** | 1.91 | 27.28 | 0.7 | 2.09 | | **61.98** | 3.84 | 2.2 | 38.02 |
| **USD/CNY** | 0.1 | 0.09 | 0.6 | 12.48 | | 0.27 | **86.3** | 0.15 | 13.7 |
| **Oil** | 1.5 | 3.87 | 0.67 | 3.59 | | 3.72 | 1.24 | **85.41** | 14.59 |
| **TO** | 8.53 | 38.8 | 5.39 | 22.8 | | 37.68 | 20.12 | 9.31 | 142.63 |
| **In. own** | 101.23 | 103.62 | 92.16 | 102.2 | | 99.66 | 106.42 | 94.72 | **cTCI/TCI** |
| **NET** | 1.23 | 3.62 | -7.84 | 2.2 | | -0.34 | 6.42 | -5.28 | **23.77/20.38** |
| **NPT** | 4 | 4 | 1 | 3 | | 2 | 6 | 1 |  |
|  | **Panel C. Trade War and Post-Pandemic Tensions” (Jan 2018 – Feb 2024)** | | | | | | | | |
|  | **UCT** | **S&P** | **CHINA** | | **Gold** | **VIX** | **USD/CNY** | **Oil** | **FROM** |
| **UCT** | **17.88** | 9.26 | 18.12 | | 24.18 | 12.78 | 11.12 | 6.67 | 82.12 |
| **S&P** | 9.91 | **21.4** | 19.73 | | 11.39 | 22.07 | 7.04 | 8.45 | 78.6 |
| **CHINA** | 19.3 | 11.66 | **23.66** | | 13.09 | 10 | 11.12 | 8.18 | 76.34 |
| **Gold** | 8.17 | 5.23 | 14.87 | | **38.77** | 6.11 | 19.17 | 7.67 | 61.23 |
| **VIX** | 10.99 | 12.84 | 20.58 | | 18.76 | **17.35** | 12.59 | 6.89 | 82.65 |
| **USD/CNY** | 18.41 | 5 | 26.82 | | 15.88 | 5.41 | **17.8** | 7.18 | 82.2 |
| **Oil** | 12.29 | 11.88 | 7.24 | | 14.08 | 22.13 | 13.38 | **18.36** | 81.64 |
| **TO** | 79.08 | 59.38 | 107.94 | | 97.38 | 81.55 | 74.42 | 45.04 | 544.78 |
| **In. own** | 96.95 | 80.78 | 131.61 | | 136.14 | 98.9 | 92.22 | 63.4 | **cTCI/TCI** |
| **NET** | -3.05 | -19.22 | 31.61 | | 36.14 | -1.1 | -7.78 | -36.6 | **90.80/77.83** |
| **NPT** | 4 | 4 | 4 | | 4 | 3 | 3 | 1 |  |

**Notes:** This table presents the connectedness metrics for the system variables based on a TVP-VAR forecast error variance decomposition. Panel A displays results for the entire sample period (January 1993 to December 2024), while Panels B and C summarize the findings for the pre-trade war globalization phase (January 1993 to December 2017) and the trade war and post-pandemic phase (January 2018 to December 2024), respectively.

**Figure 1: Returns over the entire sample period**

**Entire Period**



**Period 1: Pre-Trade War Globalization**

תמונה שמכילה טקסט, צילום מסך, עלילה, קו

תוכן בינה מלאכותית גנרטיבית עשוי להיות שגוי.

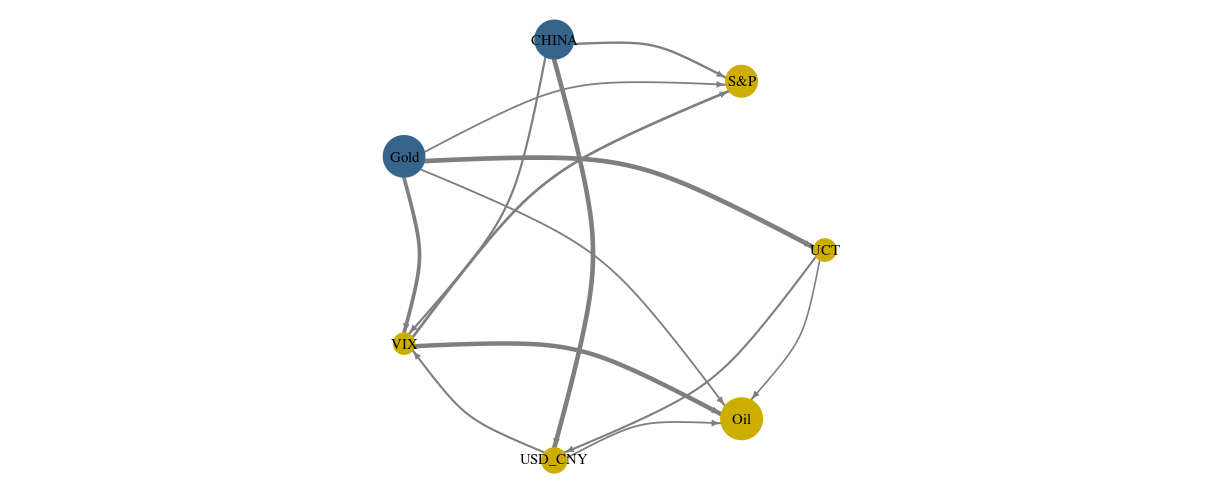
**Period 2: Trade War and Post-Pandemic Tensions (Jan 2018 – Feb 2024)**

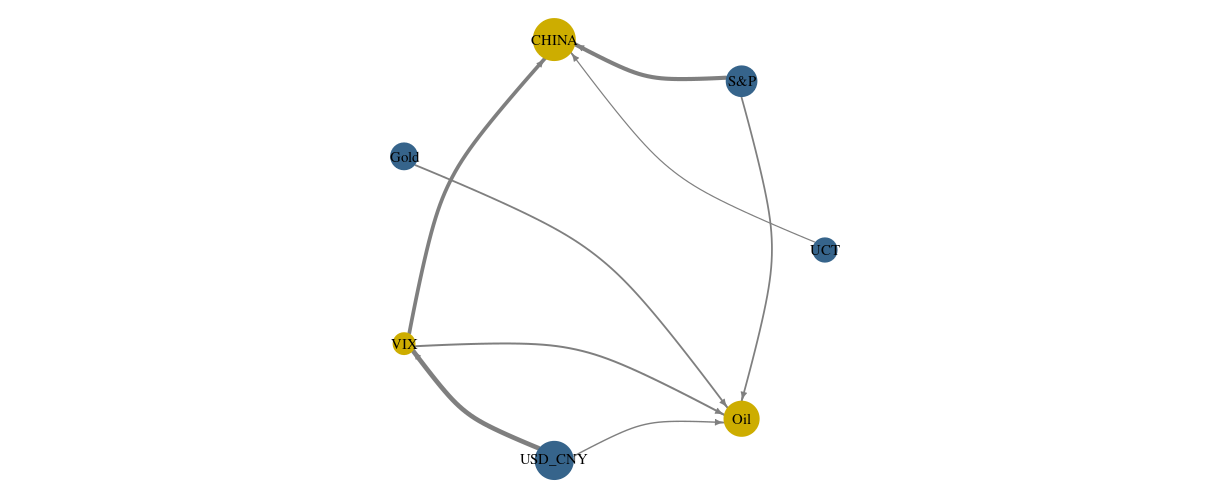
תמונה שמכילה טקסט, גופן, צילום מסך, קו

תוכן בינה מלאכותית גנרטיבית עשוי להיות שגוי.

Figure 1 displays the return series of the variables examined in the network analysis for the entire sample (January 1993 to February 2024) and the two subperiods analyzed in this study. The variables include the U.S.-China Tension Index (UCT), the S&P 500 Index (S&P), the CSI 300 Index (CHINA), gold prices (Gold), the VIX Index (VIX), the USD/CNY exchange rate (USD\_CNY), and crude oil prices (Oil). The first panel shows the returns for the entire sample, while the second panel focuses on the pre-trade war globalization period (January 1993 to December 2017). The third panel presents the returns during the trade war and post-pandemic tensions period (January 2018 to February 2024).

**Figure 2: Evolution of Spillover Networks Across the Subperiods**





**Notes**: The figure illustrates the network connectedness structures among the system variables based on the TVP-VAR forecast error variance decomposition across three periods. The left-hand graph depicts the network during the pre-trade war globalization period (January 1993 to December 2017), and the right-hand graph presents the network for the trade war and post-pandemic tensions period (January 2018 to February 2024). The variables examined include the U.S.-China Tension Index (UCT), S&P 500 Index (S&P), CSI 300 Index (CHINA), Gold prices (Gold), VIX Index (VIX), USD/CNY exchange rate (USD\_CNY), and crude oil prices (Oil). Arrow directions indicate the direction of spillovers, while the thickness of the connections reflects the magnitude of the transmission between nodes. The figure highlights the evolution from a less connected system in the earlier period to a densely interconnected structure in the later period, emphasizing how geopolitical tensions and global crises amplify systemic linkages across financial markets

**Figure 3: Dynamic Total Connectedness Over the Full Sample Period (1993–2024)**



Notes: The figure depicts the Total Connectedness Index (TCI) computed using a TVP-VAR forecast error variance decomposition across the full sample period from January 1993 to February 2024. The TCI measures the proportion of the forecast error variance in the system attributable to cross-variable spillovers, providing a dynamic indicator of systemic connectedness within the network of variables under examination: the U.S.-China Tension Index (UCT), S&P 500 Index (S&P), CSI 300 Index (CHINA), gold prices (Gold), VIX Index (VIX), USD/CNY exchange rate (USD\_CNY), and crude oil prices (Oil). Higher values indicate periods of elevated interconnectedness, often corresponding to episodes of tensions, financial crises, and global shocks. Lower values reflect periods of relative market segmentation and stability.

**Figure 4: Dynamic Total Connectedness During the Pre-Trade War and Trade War/Post-Pandemic Periods**



Notes: The figure presents the Total Connectedness Index (TCI) computed from the TVP-VAR forecast error variance decomposition for two distinct subperiods in the analysis. The left-hand graph corresponds to the pre-trade war globalization period (January 1993 to December 2017), while the right-hand graph displays the TCI during the trade war and post-pandemic tensions period (January 2018 to February 2024). The TCI captures the proportion of forecast error variance in the system attributable to cross-variable spillovers. It serves as a dynamic indicator of systemic interconnectedness within the network of variables: The U.S.-China Tension Index (UCT), S&P 500 Index (S&P), CSI 300 Index (CHINA), gold prices (Gold), VIX Index (VIX), USD/CNY exchange rate (USD\_CNY), and crude oil prices (Oil). The increase in TCI levels and volatility in the later period highlight how tensions and global shocks have intensified systemic connectedness across markets. This heightened connectedness contrasts with the relatively less connected and more stable situations observed during the earlier period of globalization.

**Figure 5: Dynamic Net Connectedness of Each Variable During the Entire Sample Period (1993–2024)**



The figure displays the dynamic net connectedness of each variable in the system during the entire sample period from January 1993 to February 2024, derived from the TVP-VAR forecast error variance decomposition. Net connectedness is calculated as the difference between the spillovers transmitted to others and the spillovers received from others. The calculation indicates whether a variable is acting as a net transmitter (positive values) or net receiver (negative values) of shocks within the system at each point in time. The variables examined include the U.S.-China Tension Index (UCT), gold prices (Gold), crude oil prices (Oil), the S&P 500 Index (S&P), VIX Index (VIX), CSI 300 Index (CHINA), and the USD/CNY exchange rate (USD\_CNY). The plots highlight shifts in the roles of these variables throughout different market regimes and geopolitical episodes. They illustrate periods in which specific markets or the tension index transitioned from absorbers of shocks to transmitters of them, reflecting changes in systemic influences as global financial markets became increasingly interconnected.

**Figure 6: Dynamic Net Connectedness During the Pre-Trade War Globalization Period (1993–2017)**



The figure illustrates the dynamic net connectedness of each variable in the system during the pre-trade war globalization period (January 1993 to December 2017), calculated from the TVP-VAR forecast error variance decomposition. Net connectedness is measured as the difference between the spillovers each variable transmits to others and the spillovers it receives, indicating periods where a variable functions as a net transmitter (positive values) or net receiver (negative values) of shocks. The variables displayed include the U.S.-China Tension Index (UCT), gold prices (Gold), crude oil prices (Oil), the S&P 500 Index (S&P), VIX Index (VIX), CSI 300 Index (CHINA), and the USD/CNY exchange rate (USD\_CNY). These dynamics provide insights into the influence that these variables had on financial markets during a period characterized by increasing global integration, relative market stability, and the rise of China as a major economic player. They also highlight instances of elevated spillover activity during localized market and geopolitical shocks.

**Figure 7: Dynamic Net Connectedness During the Trade War and Post-Pandemic Period (2018–2024)**



The figure illustrates the dynamic net connectedness of each variable during the trade war and post-pandemic period (January 2018 to February 2024), computed using the TVP-VAR forecast error variance decomposition. Net connectedness represents the difference between the spillovers that a variable transmits to others and the spillovers it receives, indicating whether it is acting as a net transmitter (positive values) or net receiver (negative values) of shocks over time. The variables displayed include the U.S.-China Tension Index (UCT), gold prices (Gold), crude oil prices (Oil), the S&P 500 Index (S&P), VIX Index (VIX), CSI 300 Index (CHINA), and the USD/CNY exchange rate (USD\_CNY). The plots reveal distinct shifts in the roles of these variables during this turbulent period. They highlight how geopolitical tensions, pandemic-related shocks, and global market stress have shaped the transmission of systemic risk across financial markets and commodities. In particular, they illustrate pronounced periods of volatility-driven spillover activities and role reversals in key markets.

**Appendix A: Selected Academic Studies on the Financial and Economic Effects of U.S.–China Tensions**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference** | **Topic / Theme** | **Type of Risk / Index Used** | **Asset Classes Analyzed** | **Model or Method Used** | **Period Covered** | **Geographic Scope** | **Key Findings** | **Relevance to Current Study** |
| Li, S., Chen, H., & Chen, G. (2025). The US-China tension and fossil fuel energy price volatility relationship. *Finance Research Letters, 74*, 106707. | US-China tensions and fossil fuel price volatility | US-China Tension Index (UCT) | Oil, gas, coal | GARCH-MIDAS | 2010–2024 | Global (focus on US-China) | US-China tensions significantly raise volatility in fossil fuel prices, with variation across energy types | Supports UCT as a relevant risk index affecting commodity spillovers |
| Liu, L., Gozgor, G., & Pal, S. (2025). The impact of the US-China tensions on FDI dynamics in emerging economies. *Finance Research Letters, 78*, 107255. | US-China tensions and FDI in emerging markets | Geopolitical Tension Index | FDI flows in emerging economies | Panel regression, dynamic models | 2005–2024 | Emerging markets | Bilateral tensions reduce FDI, with variation across sectors and regions | Demonstrates real-economy investment channels of geopolitical risk |
| Peng, C., Deng, H., Xie, J., & Liu, X. (2025). US-China Tension and Stock Market Performance in US and China: New Insights from Time-varying Quantile Causality Method. *Finance Research Letters*, 107888. | US-China tension and stock market performance | US-China Tension Index (UCT) | US and China stock indices | Time-varying quantile causality | 2000–2024 | US and China | UCT significantly affects returns asymmetrically across quantiles; greater impact in lower tail during high tension | Provides market-based evidence of bilateral tension effects |
| Sha, F., Meng, J., Zheng, X., & Jiang, Y. (2025). Sustainability Under Fire: How China-US Tensions Impact Corporate ESG Performance? *Finance Research Letters*, 107882. | ESG performance under geopolitical stress | US-China Tension Index (UCT) | ESG metrics, firm-level data | Panel regression | 2010–2023 | China, US multinational firms | US-China tension reduces corporate ESG scores, especially in tech | Extends tension effects to non-financial corporate outcomes |
| Cai, Y. (2025). US-China tensions, global supply chains pressure, and global economy. *Economics Letters, 250*, 108120. | US-China tensions and global supply chains | Political Tension Index, Supply Chain Pressure Index | Macroeconomic aggregates, supply chains | SVAR | 2000–2024 | Global | Bilateral tensions causally impair global supply chains and output | Adds real-economy transmission channel beyond financial markets |
| Liu, X., & Zhang, X. (2024). Geopolitical risk and currency returns. *Journal of Banking & Finance, 161*, 107097. | Geopolitical risk and currency returns | Geopolitical Risk Index (GPR), US-China focus | Currency excess returns | GARCH, asset pricing regressions | 2000–2023 | Global | Geopolitical risk strongly affects currency returns; bilateral tensions have amplified effects | Confirms that geopolitical risk significantly affects exchange rate markets |

1. See Appendix A for a summary of recent studies on U.S.-China tensions. [↑](#footnote-ref-1)
2. We define the exchange rate variable as the USD/CNY rate, where an increase indicates a depreciation of the Chinese yuan against the U.S. dollar. [↑](#footnote-ref-2)
3. We used the online platform in <https://sites.google.com/view/davidgabauer/econometric-code>. We thank Professor David Gabauer for sharing his platform. [↑](#footnote-ref-3)